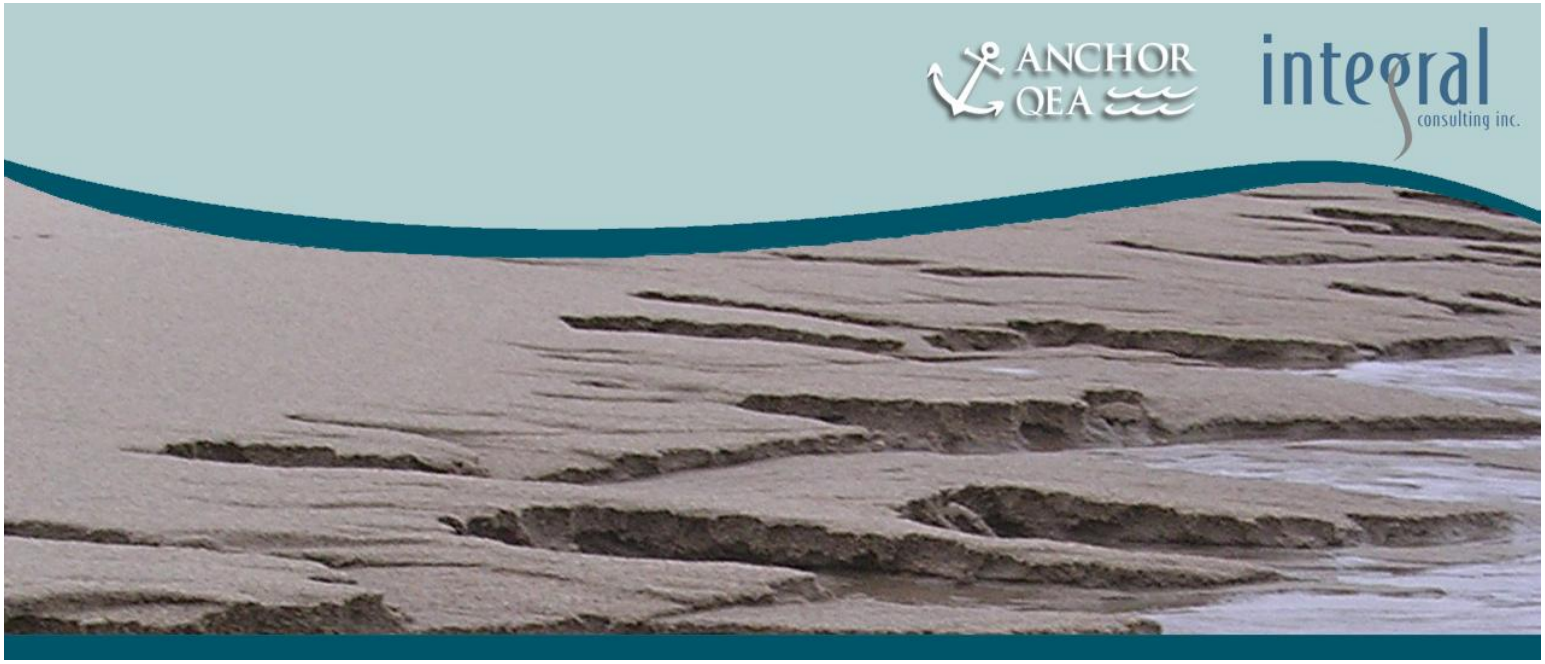

DRAFT REMEDIAL INVESTIGATION REPORT ADDENDUM 1
SAN JACINTO RIVER WASTE PITS SUPERFUND SITE

Prepared for

International Paper Company

U.S. Environmental Protection Agency, Region 6

Prepared by

Anchor QEA, LLC

614 Magnolia Avenue

Ocean Springs, Mississippi 39564

Integral Consulting Inc.

411 1st Avenue S, Suite 550

Seattle, Washington 98104

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LIST OF ACRONYMS AND ABBREVIATIONS

COC	chemical of concern
COPC	chemical of potential concern
CSM	conceptual site model
FS	Feasibility Study
gpd	gallons per day
GWBU	Groundwater-bearing unit
GWBU-A	alluvial GWBU from the land surface to the Beaumont Clay
GWBU-B	Beaumont clay/silt interface GWBU just below the lower extent of the Clay within the Chicot Aquifer
$^{GW}GW_{Class3}$	TRRP protective concentration level for Class 3 groundwater
$^{GW}GW_{Ing}$	TRRP protective concentration level for groundwater ingestion
I-10	Interstate Highway 10
IPC	International Paper Company
MCL	maximum contaminant levels
mg/L	milligrams per liter
MIMC	McGinnes Industrial Maintenance Corporation
PCB	polychlorinated biphenyl
PCL	protective concentration level
pg/L	picograms per liter
PSCR	Preliminary Site Characterization Report
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
TCEQ	Texas Commission on Environmental Quality
TDS	total dissolved solids
TEQ_{DF}	tetrachlorinated dibenzo-*p*-dioxin toxic equivalents
$TEQ_{DF,M}$	TEQ concentration calculated for dioxin and furan congeners using toxic equivalents factors for mammals
TRRP	Texas Risk Reduction Program
TSS	total suspended solids
UAO	Unilateral Administrative Order
USEPA	U.S. Environmental Protection Agency

1 INTRODUCTION

This Remedial Investigation (RI) Report Addendum 1 was prepared on behalf of International Paper Company (IPC), pursuant to the requirements of Unilateral Administrative Order (UAO), Docket No. 06-03-10, issued by the U.S. Environmental Protection Agency (USEPA) to IPC and McGinnes Industrial Maintenance Corporation (MIMC; collectively referred to as the Respondents) on November 20, 2009 (USEPA 2009). The UAO directs IPC and MIMC to conduct a Remedial Investigation and Feasibility Study (RI/FS) for the San Jacinto River Waste Pits Superfund Site in Harris County, Texas.

The UAO describes in its findings of fact a basic history of paper mill waste impoundments located north of I-10 within USEPA's Preliminary Site Perimeter. USEPA subsequently required investigation of an impoundment located to the south of I-10, citing historical documents indicating possible waste disposal activities in that area. This document addresses only the "southern impoundment" or "impoundment south of I-10." The area of investigation south of I-10 is defined as "Soil Investigation Area 4" (Figure 1-1) and adjacent sampled areas, because USEPA has required sampling of soil and groundwater within and also to the west and south of Soil Investigation Area 4 on the peninsula south of Interstate Highway 10 (I-10).

The RI Report (Integral and Anchor QEA 2013) presented results of groundwater sampling that had been conducted south of I-10 prior to submittal of the RI Report. However, in January of 2013, USEPA indicated that additional sampling of groundwater in the area of investigation south of I-10 would be required (Miller G. pers. comm. January 10, 2013). This RI Report Addendum presents the results of that final phase of groundwater sampling conducted in 2013, reviews previously presented information on groundwater, and presents a final conceptual site model (CSM) for the area of investigation south of I-10. This document is a companion to the RI Report, and incorporates that document by reference.

1.1 Summary of USEPA Requirements and Respondent Actions

USEPA's requirements for sampling in the area of investigation south of I-10 have evolved during the course of the RI. USEPA first stated that it would require sampling of soils south of I-10 in comments on the draft RI/FS Work Plan (Tzhone S. 2010 pers. comm.) sent August

2010.[1] Soil analytes for that program (Phase I) included only the chemicals of potential concern identified in Table 14 of the Chemicals of Potential Concern (COPC) Technical Memorandum (Integral 2011b), and sampling was conducted in March 2011 in accordance with Sampling and Analysis Plan: Soil Study, Addendum 1 (Integral 2011a).

Based on its comments on the Preliminary Site Characterization Report (PSCR; Integral and Anchor QEA 2012), USEPA required additional soil sampling, sediment sampling, and groundwater sampling in and adjacent to Soil Investigation Area 4 (Phase II sampling). Groundwater sampling at three locations within Soil Investigation Area 4 was required by USEPA to address uncertainties about the potential for groundwater to transport chemicals from soils in the area of investigation south of I-10 to surface water (Miller G. pers. comm. December 11, 2011). Only shallow groundwater above native, undisturbed material (i.e., shallower than approximately 25 feet below ground surface) was sampled in 2012. For this second sampling event, USEPA greatly expanded the list of chemicals to be analyzed in soils and groundwater, including more than 120 analytes not evaluated in other aspects of the RI/FS. All related soil, sediment, and groundwater samples were collected in May 2012. The Phase II groundwater-related activities were conducted in accordance with the Groundwater Sampling and Analysis Plan (SAP) Addendum.

Finally, following submittal of the draft RI Report, USEPA indicated a requirement for additional groundwater sampling in the vicinity of locations in which 2,3,7,8-tetrachlorinated dibenzo-*p*-dioxin toxicity equivalent (TEQ_{DF})[2] concentrations in subsurface soil were elevated. This final sampling effort (Phase III) was conducted in two parts, as described in Groundwater SAP Addendum 2 (Anchor QEA and Integral 2013):

- An additional shallow well (SJMW004S) was installed between the soil cores with the highest TEQ_{DF} soil concentrations, and sampled in May 2013.
    - Information on sustainable well yield and groundwater surface elevation was collected at all four existing monitoring wells during this sampling event.
- As described in Groundwater SAP Addendum 2, because concentrations of one or

[1] The investigation under the UAO with respect to the peninsula south of I-10 has been conducted by IPC only.
[2] The subscript "DF" indicates that the TEQ was calculated using dioxins and furans, and toxic equivalency factors for mammals from van den Berg et al. (2006).

more analytes in the SJMW004S sample were greater than its respective USEPA maximum contaminant level, or a Texas water quality criterion, two additional wells were installed and sampled in July 2013:

- One sample was collected at a location adjacent to the new shallow well, but in deeper groundwater, immediately below the Beaumont Clay (SJMW004D).
- An additional shallow well was installed to the west of Soil Investigation Area 4 (SJMW005) between SMJW004S and the the shoreline of the river[3].
- Information on sustainable well yield and groundwater surface elevation was collected at the two new monitoring wells during this sampling event.

All of the groundwater sampling locations are shown in Figure 1-2.

The sampling program and results of the first two sampling efforts are described in the investigation summary in Sections 2.1 and Section 6.2 of the RI Report (Integral and Anchor QEA 2013), respectively. This RI Report Addendum presents the results of the third phase of sampling, and a synthesis of all of the groundwater data from south of I-10 in a final refinement of the CSM for the area of investigation south of I-10.

1.2 Objectives of the RI Report Addendum

Because the final groundwater sampling required by USEPA was not conducted until after submittal of the final RI Report, an addendum to the RI Report is necessary to present the results of the final groundwater sampling, which was a part of the remedial investigation. This RI Report Addendum was prepared to present results of groundwater sampling conducted in 2013, and to place resulting information in the context of the larger body of information from the area of investigation south of I-10. The objectives of this RI Report Addendum are as follows:

- Provide a comprehensive report of the results of the Phase III groundwater sampling conducted in May and July of 2013.
- Synthesize the information on groundwater in a final CSM for the area of investigation south of I-10.

[3] The embayment to the west of Soil Investigation Area 4 is known as the "Old River."

USEPA is currently reviewing the draft Feasibility Study (FS; Anchor QEA 2013a) which presents remedial alternatives for the area within USEPA's Preliminary Site Perimeter, including the area of investigation south of I-10. Final documentation and synthesis of information is necessary for USEPA to complete the process of remedy selection.

1.3 Report Organization

The remedial investigation south of I-10 included development of empirical information, review and synthesis of historical information, human health and ecological risk assessment, source evaluation and a fate and transport analysis. The results of this work are presented in detail in Section 6 of the RI Report. New information developed during 2013 includes the following:

- Groundwater elevation and well yield information from all six wells installed as part of the RI south of I-10 to address uncertainties about groundwater classification, hydraulic gradients and flow direction for the area of investigation south of I-10.
- Groundwater chemistry for two shallow wells that were installed as part of Phase III and therefore had not been previously sampled (SJMW004S and SJMW005).
- Groundwater chemistry for one deep well that was installed as part of Phase III and therefore had not been previously sampled (SJMW004D).

This RI Report Addendum first presents results describing the local hydrogeological setting, in Section 2, because this context is relevant to the interpretation of chemistry data. New chemistry results are presented and screened in Section 3, and are evaluated in the context of prior sampling. Following presentation and evaluation of the most recent groundwater data, a final CSM is presented. Relevant chemistry validation reports are provided in Appendix A; all groundwater analytical data, including non-detect results, are presented in Appendix B. Groundwater resource evaluation test results are provided in Appendix C.

2 HYDROGEOLOGICAL SETTING

Section 3.5.2 of the RI Report describes the soil types, soil grain sizes, color, structure, presence of debris, sheen, and odor from 26 borings and three surface soil samples collected south of I-10 as part of this investigation. Physical information and corresponding TEQ_{DF} concentrations are illustrated in detail in that report. On the basis of a combination of physical characteristics including color, structure, vegetation, and elevation, silt and clay are generally considered to be either fill or undisturbed (i.e., native) soil. Available information suggests that up to approximately 27 feet of these materials is fill placed on top of or mixed into the top of natural alluvial sediments, depending on the particular soil core location.

Surface and shallow subsurface soils in Soil Investigation Area 4 differ from material retrieved in sediment cores north of I-10. The only similarities occur in the four deepest soil units identified in Soil Investigation Area 4: the dark gray to black clay, the underlying light gray silty sand or silt, the greenish-gray to reddish mottled Beaumont Clay unit, and the deepest unit, a gray silty sand, identified immediately below the Beaumont Clay. Based on the observations presented in core logs, the deepest portions of the black clay and all deeper units found in cores collected south of I-10 are interpreted to be undisturbed, naturally occurring deposits. Units above these undisturbed deposits are interpreted to be fill materials, and contain a mixture of clay, silt, sand, and gravel with varying amounts of anthropogenic debris.

In this context, the groundwater sampling conducted in Phases II and III has been largely in the fill material, as required by USEPA (Integral 2011a). Sampling conducted in 2013 included at USEPA's direction, one deep groundwater location (SJMW004D) screened well below the fill, and also below the Beaumont Clay. A description of the hydrology, including site-specific observations not previously presented, is provided in this section.

2.1 Regional and Local Hydrogeology

The regional and local hydrogeologies are described in detail in Section 3.6 of the RI Report; the following is a brief summary of that discussion. USEPA's Preliminary Site Perimeter, located in Harris County, is above the Evangeline (deeper) and Chicot (shallower) aquifers. The near-surface stratigraphy within USEPA's Preliminary Site Perimeter consists of the

uppermost units of the Chicot Aquifer. Recharge to the Chicot Aquifer occurs primarily in the northern up-dip outcrop areas where the Beaumont Formation is thinner or nonexistent. This area of recharge for the Chicot Aquifer is located approximately 10 to 20 miles upgradient of USEPA's Preliminary Site Perimeter. The Chicot Aquifer is used as a drinking water source within the greater Houston area, but, in general, water used from this source is pumped from wells screened at least several hundred feet below the Beaumont Clay. Although there are some privately owned wells in the upper Chicot Aquifer near USEPA's Preliminary Site Perimeter, the infiltration of surface waters or shallow groundwater would be prevented by the thick sequence of the clay and silt deposits of the Beaumont Formation effectively isolating the lower portion of the Chicot Aquifer from shallower groundwater and surface water in the vicinity (U.S. Geological Survey 2002).

Implementation of the Groundwater SAP (describing sampling north of I-10) and Groundwater SAP Addenda 1 and 2 on the peninsula south of I-10 has generated information on groundwater potentiometric surfaces, direction of flow, and groundwater chemistry. Information descriptive of the site-specific, near-surface groundwater regime is provided in the following sections.

2.2 Local Hydrogeology

The first three wells installed within Soil Investigation Area 4 in Phase II were constructed with screened intervals above native materials and intercepted the observed unconfined potentiometric surface (i.e., water table), per USEPA requirements. One groundwater bearing unit (GWBU) was identified as a result of the groundwater sampling south of I-10 during Phase II of the investigation of this area. This GWBU is termed alluvial GWBU from the land surface to the Beaumont Clay (GWBU-A(s)) and is similar to GWBU-A under the northern impoundments in that it is characterized by unconfined groundwater found in the shallow alluvium near land surface. Groundwater from GWBU-A(s) is not used within 0.5 miles of the groundwater sampling locations in a manner that could result in human or ecological exposure.

In 2013, during Phase III, monitoring wells SJMW004S and SJMW005 were installed in GWBU-A(s), and monitoring well SJMW004D was installed and screened just below the

Beaumont Clay. The screened interval for well SJMW004D correlates with a Beaumont Clay/silt interface GWBU just below the lower extent of the clay within the Chicot Aquifer (GWBU-B) identified north of I-10 (i.e., groundwater below the Beaumont Clay/silt interface). Similar to GWBU-A(s) groundwater, groundwater from GWBU-B(s) is not used within 0.5 miles of the groundwater sampling locations in a manner that could result in human or ecological exposure.

The information in this section includes data to address the state's evaluation criteria used in the determination of the "class" of the groundwater resource in the area, because the class of the groundwater resource determines, in part, the acceptable concentrations of chemical analytes. Three categories of groundwater resources are identified by the State of Texas, designated Class 1, Class 2, and Class 3. These are based upon a site-specific evaluation of the current use of the GWBU, as well as its potential use, as defined on the basis of natural water quality and well yield. Saturated geologic units can be identified most readily by their capability to transmit water to an open borehole. Only saturated geologic units with hydraulic conductivities of 1 x 10^{-5} cm/sec meet the definition of GWBU in §350.4(a)(40) and must be classified as Class 1, Class 2, or Class 3 groundwater (Texas Commission on Environmental Quality; TCEQ 2010). Saturated geologic units with hydraulic conductivities of K < 1 x 10^{-5} cm/sec are not subject to the classification requirements of §350.52[4]. The productivity testing was conducted consistent with TCEQ RG-366/TRRP-8 (TCEQ 2010) and, specifically followed Method 2c referenced therein (direct determination of well yield by equilibrium discharge). GWBU-A(s) was tested via SJMW001, 002, 003, 004S, and 005. GWBU-B(s) was tested via SJMW004D.

Water level data obtained from the GWBU-A(s) wells on July 12, 2013, indicate a generally westward flow direction[5] (Figure 2-1). Similar to groundwater flow behavior in the vicinity of the impoundments north of I-10, shallow groundwater flow on the peninsula south of I-10 mimics topography in the unconsolidated materials. Additional groundwater sampling

[4] Calculated hydraulic conductivities for the wells installed south of I-10 range between 1.8 x 10^{-1} and 1.02 x 10^{-5} cm/sec (SJMW003 and SJMW001, respectively).

[5] Although water level data was obtained from SJMW004D, a potentimetric surface map for groundwater below the Beaumont Clay is not producible, as only one data point from this hydrogeologic regime is available (i.e., there is only one monitoring well installed in groundwater below the Beaumont Clay).

conducted in Phase III refined the description of the groundwater resource in Soil Investigation Area 4, as described below.

2.2.1 Groundwater Resource Productivity Evaluation

All six monitoring wells were tested to obtain groundwater productivity information. Monitoring wells SJMW001 (GWBU-A[s]) and SJMW004D (GWBU-B[s]) estimated sustainable yields are less than 150 gallons per day (gpd). All other wells exhibited estimated sustainable well yields greater than 150 gpd. Well test analysis data are provided in Appendix C, and are synthesized with other aquifer characteristics in Section 2.3.2 to assess groundwater classification at the site.

2.2.2 Conventional Groundwater Quality

As described in the RI Report and confirmed during the 2013 sampling, groundwater quality south of I-10 is generally comparable to that of nonpotable aquifers on the basis of total dissolved solids (TDS)[6] and, to some extent, total suspended solids (TSS) and conventional analytes (i.e., pH, conductivity, dissolved oxygen, turbidity, oxidation/reduction potential, and temperature). The 2013 Groundwater Field Sampling Report (Anchor QEA 2013b) provides a summary of conventional groundwater data obtained from the Phase III wells. Specifically, in samples collected in 2012, TDS values in GWBU-A(s) were 2,730 milligrams per liter (mg/L) in SJMW001, 1,520 mg/L in SJMW002, and 5,040 mg/L in SJMW003. TDS values in samples collected in 2013 were within this range at 2,530 mg/L in SJMW004S, 3,170 mg/L in SJMW004D, and 2,120 mg/L in SJMW005.

2.3 Refined Hydrogeological Model for the Area of Investigation South of I-10

2.3.1 Groundwater Flow

Potentiometric surface data obtained from new wells SJMW004S, SJMW004D, and SJMW005 allow refinement of the hydrogeological model for the area of investigation south

[6] Per TCEQ RG-366/TRRP-8 (TCEQ 2010), Class 1 (i.e., potable) groundwater TDS may not exceed 3,000 mg/L; two of five monitoring wells south of I-10 exhibit TDS concentrations above 3,000 mg/L.

of I-10. Similarly, aquifer testing activities of all wells south of I-10 resulted in data that further refines the groundwater resource classification south of I-10.

Conclusions regarding shallow groundwater behavior remain consistent with those provided in the RI Report. Specifically, shallow groundwater flows westward across the investigation area towards the Old River. This behavior is also consistent with anticipated conditions in these unconsolidated materials and the peninsular nature of the investigation area.

Deeper (i.e., immediately below the Beaumont Clay) groundwater behavior is consistent with conditions noted north of I-10, in that the potentiometric surface of GWBU-B is lower than the potentiometric surface of groundwater found in alluvial materials (GWBU-A).

2.3.2 Aquifer Classification

Data obtained during the groundwater resource productivity testing allows estimation of the daily yield reasonably attainable from the GWBU in the tested location. Table 2-1 below summarizes those data, and Appendix C presents the well test analyses.

Table 2-1
Groundwater Resource Testing Data

Well	TDS (mg/L)	Time Pumped	% Drawdown	Transmissivity (ft^2/min; see Appendix A)	Approximate 24 hour minimum discharge ("Q"; gallons[7])
SJMW001	2,730	2 hr 45 min	100% (went dry)	0.0002758	<110
SJMW002	1,520	3 hr 25 min	7%	0.2731	11,400
SJMW003	5,040	3 hr 54 min	1%	4.27	114,000
SJMW004S	2,530	4 hr 38 min	8%	0.01495	1,140
SJMW004D	3,170	5 hr 37 min	1%	0.0007632	<110
SJMW005	2,120	5 hr 8 min	2%	0.04036	1,140

[7] J. Krasny, *Classification of Transmissivity Magnitude and Variation*, Ground Water, March-April 1993.

Using the regional public water supply and groundwater use information, presented originally in the RI Report, TDS analytical data from each monitoring well, the well yield estimates recently obtained during the Phase III work, and Figure 1 from TCEQ RG-366/TRRP-8, the following groundwater resource classifications were determined.

- GWBU-A(s)
  - Class 2 Areas
    - SJMW002: TDS <3,000 mg/L; 150 gpd < Q < 144,000 gpd
    - SJMW003: 3,000 mg/L < TDS < 10,000 mg/L; Q > 150 gpd
    - SJMW004S: TDS <3,000 mg/L; 150 gpd < Q < 144,000 gpd
    - SJMW005: TDS <3,000 mg/L; 150 gpd < Q < 144,000 gpd
  - Class 3 Area
    - SJMW001: TDS <3,000 mg/L; Q < 150 gpd
- GWBU-B(s)
  - Class 3 Area
    - SJMW004D: 3,000 mg/L < TDS < 10,000 mg/L; Q < 150 gpd

As demonstrated in this section, and regardless of any chemical constituents present, groundwater resources at the site do not qualify as a drinking water source. Although comparison to USEPA maximum contaminant levels (MCLs) was discussed in Groundwater SAP Addendum 2, on the basis of the groundwater classification discussed in this section, MCLs are not applicable. Therefore, the screening evaluations in the next section do not include comparisons of analytical results to MCLs.

3 CHEMICAL SCREENING AND POTENTIAL FOR SUBSURFACE TRANSPORT

This section presents a summary of the results of all of the groundwater sampling conducted south of I-10 in 2012 and 2013 relative to screening values.

3.1 Analyte Detection Frequency

A total of 171 chemicals, TSS, and TDS were analyzed in six discrete groundwater samples. Over half of these were not detected in any groundwater sample (97 analytes); Concentrations of the 74 analytes, TSS, and TDS that were detected in at least one groundwater sample are presented in Table 3-1; the full list of analytes, including those never detected, is provided in Appendix B, with corresponding information on concentrations. Those never detected are shown at one-half their detection limits. The compounds listed on Table 3-1 are subject to screening, as described in Section 3.2.

3.2 Screening Evaluation of Groundwater

Table 3-2 provides the analytical data for TSS, TDS, COPCs, and those analytes required by USEPA that are not COPCs, which were detected in at least one groundwater sample collected south of I-10.

Analytical data were screened against Texas Risk Reduction Program Protective (TRRP) Concentration Levels for Class 2 groundwater resources (i.e., $^{GW}GW_{Ing}$ protective concentration levels [PCLs]) and Class 3 groundwater resources (i.e., $^{GW}GW_{Class3}$ PCLs), consistent with the determination in Section 2.3.2 of the varying groundwater resource classes identified for the area south of I-10. Of the 74 chemical analytes detected in at least one sample, 72 chemicals (including all USEPA required non-COPCs) were at concentrations below all PCLs in all groundwater samples.

As previously presented in the RI Report, arsenic was estimated in SJMW002 (a Class 2 groundwater resource) at 0.0105 mg/L. It was estimated at 0.0094 mg/L, essentially at the $^{GW}GW_{Ing}$ PCL of 0.01 mg/L, in the filtered sample from that well.

The $TEQ_{DF,M}$ concentration in the unfiltered sample from SJMW004S (a Class 2 groundwater resource) was estimated at 60.2 picograms per liter (pg/L), and the dissolved (filtered)

$TEQ_{DF,M}$ concentration was 9.22 pg/L. The unfiltered sample concentration of $TEQ_{DF,M}$ was above the $^{GW}GW_{Ing}$ PCL of 30 pg/L for that parameter. Dioxins and furans in that sample were likely associated with suspended particulate material, as shown by the significantly lower $TEQ_{DF,M}$ concentration in the filtered sample. In samples collected in 2012, a $TEQ_{DF,M}$ concentration of 47.3 pg/L was identified in well SJMW001 in an unfiltered sample. Because the groundwater resource at this location was demonstrated to be Class 3 (Section 2.3.2), the applicable $^{GW}GW_{Class3}$ PCL is 3,000 pg/L, and was not exceeded.

3.3 Conclusions of Screening Evaluation

Both GWBU-B(s) and the northern portion of GWBU-A(s) are determined to be Class 3 groundwater resources. The remaining portions of GWBU-A(s) in Soil Investigation Area 4 are consistent with a Class 2 groundwater resource. Based on the previously reported groundwater investigation results and the new 2013 data, the following conclusions were reached. These conclusions are consistent with and confirm the conclusions presented in the RI Report.

- The majority of COPC concentrations in groundwater are below the most stringent PCLs promulgated by TCEQ (i.e., $^{GW}GW_{Ing}$ PCLs).
- Concentrations in groundwater of all of the USEPA-required analytes that are not COPCs are below the most stringent PCLs promulgated by TCEQ (i.e., $^{GW}GW_{Ing}$ PCLs).
- Concentrations of all analytes sampled in GWBU-B are well below the most stringent PCLs promulgated by TCEQ (i.e., $^{GW}GW_{Ing}$ PCLs).
- Two exceedances of applicable PCLs were observed, both in shallow groundwater (i.e., GWBU-A[s]).
    - Arsenic in SJMW002, with an estimated concentration of 0.0105 mg/L essentially at the $^{GW}GW_{Ing}$ PCL of 0.01 mg/L.
    - $TEQ_{DF,M}$ in SJMW004S at an estimated concentration of 60.2 pg/L, above the PCL of 30 pg/L. It is important to emphasize the dissolved $TEQ_{DF,M}$ concentration in SJMW004S was an estimated value, an order of magnitude lower and below the PCL (9.22 pg/L), indicating the likely influence of suspended particulates on $TEQ_{DF,M}$ concentrations.

3.4 Potential for Subsurface Transport of Dioxins and Furans

Filtered groundwater samples were collected from GWBU-B in a well (SJMW004D) located between the two soil cores with the highest dioxin and furan concentrations in soils, and from GWBU-A in a location to the west of that deep well, at SJMW005. In these two samples, the 2,3,7,8-substituted dioxin and furan congeners were not detected, either in the whole groundwater (Table 3-1) or the filtered groundwater (Table 3-2). The apparent absence of dioxin and furan congeners in these samples indicates that there is no subsurface transport pathway for these chemicals from any paper mill waste in the southern impoundment to the deeper aquifer, and that there is no lateral transport of dioxins and furans in GWBU-A to the aquatic environment.

4 FINAL CONCEPTUAL SITE MODEL

The CSM for the area of investigation south of I-10 was developed in 2011 and refined in the RI Report on the basis of chemistry data for soil and groundwater, along with a review of historical documentation, aerial photographs, and anecdotal information about the history of the peninsula south of I-10. The CSM addresses chemical sources, chemical release mechanisms and transport pathways, and contemporary conditions that could result in pathways to human or ecological receptors. The discussion below includes some material abbreviated from the discussion in Section 6.6 of the RI Report, and is focused on refinements resulting from the groundwater sampling and analysis program.

4.1 Source Evaluation

As presented in the RI Report, dioxins and furans originating in paper mill wastes that were deposited in an impoundment south of I-10 beginning in 1965 and ending by no later than 1966, are chemicals of concern (COCs). Although soil affected by paper mill wastes tends to be characterized by high concentrations of $TEQ_{DF,M}$ relative to surrounding soils and relative to $TEQ_{DF,M}$ concentrations in background soils, the distinctive fingerprint of dioxins and furans in the paper mill wastes disposed of in the impoundments provides a means to distinguish paper mill waste-related dioxins and furans from those contributed by other source types. Analyses presented in the RI Report indicate that both paper mill waste-related dioxins and furans, and a mixture characteristic of common urban background sources, are present in soils south of I-10. The RI Report also established that a dioxin and furan mixture potentially from a third source is present.

There is significant evidence that paper mill wastes are not the only potential source of chemicals other than dioxins and furans in soils south of I-10. Following the detection of general debris, including wood, plastic, paint chips, and asphalt in subsurface soils in 2011, and verified during later investigations in 2012/2013, the CSM was modified to acknowledge the presence and influence of other anthropogenic wastes influencing the subsurface environment of the area of investigation on the peninsula south of I-10. Soils data developed in 2012, along with groundwater data presented in the RI Report and additional analyses of historical information, indicate possible sources of these other anthropogenic wastes. Details on the activities of other parties in the area of investigation south of I-10 (GW Services 1997)

confirm that activities conducted in the area of investigation other than the disposal of paper mill wastes likely contributed chemicals to soils and other environmental media in the area of investigation south of I-10. However, the full history of waste deposition within the peninsula south of I-10 cannot be described with available information.

4.2 Chemical Release and Transport Mechanisms

Section 6.5 of the RI Report presents a general fate and transport analysis for the area of investigation south of I-10, evaluating potential for surface and subsurface transport. Surface water flow pathways from the upland of the peninsula south of I-10 towards the Old River were found not to contribute to any potential release of paper mill waste-related dioxins and furans to the aquatic environment, including sediments. Polychlorinated biphenyls (PCBs) in sediments to the west of the peninsula south of I-10 were found to be most likely from other sources, not from buried paper mill wastes.

Following evaluation of the potential subsurface transport, the RI Report finds that there is no realistic pathway for dioxin and furans detected in shallow groundwater south of I-10 (GWBU-A(s)) to migrate to groundwater wells used for water supply, all of which in the region are located outside of USEPA's Preliminary Site Perimeter. Among the broad suite of volatile organic compounds, semivolatile organic compounds, dioxins and furans, PCBs, and metals analyzed in groundwater samples from south of I-10 in Phase II, exceedances of Texas surface water quality criteria for salt water were very limited, for lead and PCBs (see the RI Report, Section 6.5.2). Although lead exists in many compounds with various degrees of aqueous solubility, lead in environmental systems typically binds strongly to soil or sediments and is generally considered to be immobile in soil and groundwater (ATSDR 2007). As with dioxins and furans, PCBs are resistant to degradation, characterized by a strong propensity sorb to organic carbon, and have extremely low water solubility. These factors indicate a strong affinity for sediments, particularly sediments with high organic content. Because of their hydrophobic character, PCBs are not expected to migrate significantly in groundwater. Taken together, the information available from the literature and from Phase II groundwater sampling south of I-10 indicated that dissolved-phase groundwater transport is not expected to be a transport pathway for migration of PCBs or lead to the aquatic environment.

Phase III groundwater sampling was conducted partly to determine whether dioxins and furans could be transported in shallow groundwater (GWBU-A) to the aquatic environment, or whether they could be transported through deeper groundwater (GWBU-B) towards the Chicot Aquifer, which is a drinking water source. All dioxin and furan congeners that were analyzed in Phase III to address this uncertainty were below detection limits in both whole and filtered groundwater. This result is consistent with the chemical properties of dioxins and furans, which are both hydrophobic and bind strongly to organic matter (like PCBs), and which are not expected to move extensively in the groundwater environment. Results of Phase III groundwater sampling and analysis indicate that groundwater pathways from the soils affected by paper mill wastes to deep groundwater and to the aquatic environment do not exist. The CSM has been modified accordingly (Figure 4-1).

4.3 Final Conceptual Site Model for the Area of Investigation South of I-10

The final CSM for the area of investigation south of I-10 is presented in Figure 4-1. Results of the final groundwater sampling have confirmed that subsurface transport of paper-mill waste related chemicals dioxins and furans from the deposited waste to the surface water environment is not a complete pathway. Under baseline conditions, there are no complete exposure pathways linking ecological or human receptors to paper mill waste-related chemicals in groundwater.

5 SUMMARY AND CONCLUSIONS

Additional groundwater investigations required by USEPA and conducted in 2013 are summarized in this RI Report Addendum, and synthesized with the results of groundwater sampling conducted in 2012. The results of this work augment and further support the original conclusions presented in the RI Report regarding groundwater south of I-10 in Soil Investigation Area 4. These conclusions are summarized as:

- None of the groundwater sampled in Soil Investigation Area 4 are Class 1 groundwater resources according to the classification system used in Texas; only Class 2 and Class 3 groundwaters are present.
- There is no evidence that chemicals potentially associated with paper mill wastes in the area of investigation on the peninsula south of I-10 could be transported to drinking water or to the aquatic environment.
- Given that dioxins and furans associated with paper mill wastes have been demonstrated to not be mobile in the area of investigation south of I-10, available information is sufficient for risk management decision-making.
  There are no data gaps remaining for the area of investigation on the peninsula south of I-10 and the RI for this area is complete.

The draft FS (Anchor QEA 2013a), submitted prior to submittal of this RI Report Addendum, includes consideration of institutional controls to prevent exposures to dioxins and furans present in deep subsurface soils in the area of investigation south of I-10. Results of the groundwater studies, finalized herein, do not affect the nature or the range of remedial alternatives that should be considered.

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